i	ii	iii	iv	v
Element	λ/ρ	λ	D_e	λ/D_e
Na.....	4.95	4.8	.66	7.28
Mg	5.1	8.9	1.25	7.12
K	6.53	5.7	.87	6.55
Ca.....	6.47	10.0	1.28	7.8
Cu.....	6.8	60.6	6.58	9.2
Zn.....	6.95	49.4	5.23	9.45
Sr.....	8.5	21.6	2.04	10.6
Ag	8.3	87.2	8.97	9.7
I	10.8	53.5	5.17	10.3
Ba.....	8.8	32.8	3.27	10.0
Pb.....	10.8	123.0	11.0	11.2

from Crowther's table, and in column iii are given the corresponding values of λ calculated by multiplying λ/ρ by the densities in the solid form of the corresponding elements. Column iv contains the electrical density, D_e, calculated by dividing the atomic charges of the elements by their respective atomic volumes in the solid state, and column v contains values λ/D_e. It will be seen that the variations from a mean value are less in column v than in column ii. This is also shown graphically in Fig. 1, where the mass densities and the electrical densities are plotted against the absorption coefficient. The points representing the relations of the electrical densities to the corresponding absorption coefficients are indicated by circles, while the corresponding points for mass densities are indicated by crosses. It will be seen that the circles lie more nearly on a smooth curve than do the crosses.

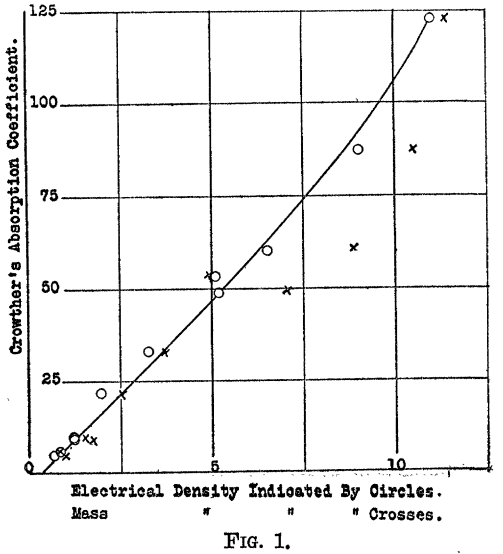

FIG. 1.

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EVIDENCE PROVING THAT THE BELLY RIVER BEDS OF ALBERTA ARE EQUIVALENT WITH THE JUDITH RIVER BEDS OF MONTANA

ON the twenty-fourth of last July a paper of mine appeared in SCIENCE in which I took the ground that the Dog Creek Beds of Montana were equivalent to the Edmonton Beds of Alberta and that the Cow Island Beds of Montana should be correlated with the Belly River series of Alberta, with the Fort Pierre deposits between. I thus took the early views of Professor E. D. Cope that the Judith River Beds were on top of the Pierre. Judging from memory, I was unable to believe that the Fort Pierre was on top of the Judith River formation. I concluded, therefore, that the sequence of rocks in Montana would be the same as those in Alberta, where the Belly River series is below the Pierre, and the Edmonton is above.

Last July, however, with Mr. D. B. Dowling, a senior geologist of the Geological Survey of Canada, and my son, Charles M., who took most of the photographs, I spent ten days in the Judith River country, going over the same region I walked over in 1876 as Professor Cope's assistant. I was soon forced by incontestable evidence to change my opinions, and accept without reservations the conclusions of Hatcher and Stanton in their fine work on the "Geology and Paleontology of the Judith River Beds." We actually added to the weight of the evidence they had gathered by the discovery, as I believe for the first time, of some sixty feet of Bear Paw shales on top of the Judith River Beds, on the head of Taffy Creek, an easterly fork of Dog Creek. Also heavy masses on top on the south side of the river near Cow Island. Mr. R. G. McConnell, deputy minister and director of the Geological Survey of Canada, has kindly allowed me to present this paper in a private capacity, Mr. Dowling being the mouthpiece of the Geolog-

ical Survey of Canada on this exploration. It was seen how easily the early explorers could have misunderstood the arrangement of the strata, as they have been tilted in all directions and at all angles. In one place great masses of the rocks, often acres in extent, have been lifted higher than newer rocks, or dropped below them. Then the stratigraphical characters of the Claggett shales resemble those of the Pierre so closely it is difficult at first view to tell them apart.

Last July we followed up the valley of Dog Creek, on the road to a sheep ranch on the prairie. A couple of miles above where the creek enters the canyon we came to a strip of Claggett shales lifted up besides the Eagle Sandstone and Judith River Beds, the shale disintegrating into rather steep slopes over which our road lay. We climbed the steep ascent to the ridge, some 600 feet above the Missouri River and followed the divide between the Badlands of the Missouri and of Dog Creek. We camped on Taffy Creek, an eastern branch of Dog Creek. We made a very thorough study of this region, making large collections of invertebrates from all the horizons, and secured *Myledaphus* and sharks' teeth from the Eagle Sandstones, which, with the Claggett shales, I am informed, forms the base of the Belly River series of Canada.

On the south side of Taffy Creek below a large timbered Hog Back, I found a locality in the gray sandstone of the Judith River Beds that may possibly be the type locality from which we got collections on that memorable expedition in 1876, when we found the first horned dinosaurs of the United States, a "blow out" as it is called in the west, where quite an area in a bed of sandstone had been denuded, I found quantities of the teeth of horned, plated, duck-billed and carnivorous dinosaurs and of *Myledaphus bipartitus* Cope, scales of ganoid fishes, vertebræ of *Champsosaurus* and many fragments of turtle shells (*Trionx,* etc.), and what delighted me more, a complete footed ischium with most of the illium and pubis of one individual of a hooded trachodont, evidently Lambe's *Stephanosaurus marginatus,* from the Belly River series of Red Deer River, Alberta. It was difficult for me not to believe I was in a Red Deer bone-bed, as the same material was strewn around here in Montana. In the Edmonton, however, the bones have the appearance of having once been flotsam along a sea shore at the limit of high tide. I only found a couple of fragments of turtle shells there, while they are very abundant in this bone-bed on Taffy Creek. Everywhere in this region are two veins of coal, on top of the Judith River Beds and immediately below the Bear Paw shales. Above each vein is an oyster bed, often three or four feet thick. In the Bear Paw shales south of camp, with the aid of a sheepherder, Mr. Dowling found a fine new Mosasaur, evidently a *Clidastes,* as the chevrons are anchylosed to the centra of the vertebræ and the end of the tail is expanded into a fin. We secured the mandibles with teeth, a lot of dorsal vertebræ, and nearly 15 feet of the tail. We also collected some fine Ammonites and Baculites as well as a couple of specimens of a Plesiosaur, resembling *Cimoliosaurus.* These fossils can not be distinguished from similar ones we procured from the Fort Pierre above the Belly River series in Dead Lodge Canyon on the Red Deer River, Alberta. But for the uplifting of the rocks the stratigraphical record would be quite simple. A little observation, however, enabled one to detect the different horizons readily. On the ground it would be impossible for one to doubt the sequence of the rocks as given by Hatcher and Stanton in the order beginning at the bottom, Eagle Sandstone, Claggett shales, Judith River Beds and Bear Paw shales on top of all.

We followed the same trail first traveled by Professor Cope down the prairie level to near Cow Island, getting water at "Lone Tree" spring as in 1876, and camped near our old camp, on the Missouri River. We found the Bear Paw shales on top of the Judith River Beds, on the south side of the river three miles below Cow Island. The only difference between the formation here and Dog Creek is the absence of the Eagle Sandstones and Claggett shales. The sculpture and lithological characters of the bad lands approached more

nearly those of the Dead Lodge Canyon on the Red Deer River. Two things have especially impressed me: First, the close resemblance between the Judith River Beds and the Belly River series in the Dead Lodge Canyon where the Fort Pierre on top and Belly River series below are nearly 500 feet thick. Towards its lower end a sandstone like the Eagle is exposed. The second is the finding of a footed ischium of a trachodont in the same bed from which the type of *Trachodon mirabilis,* of Leidy, was discovered, the same teeth to which he gave the name lying around the ischium. That evidently belongs to Lambe's *Stephanosaurus marginatus:* a crested trachodont. My party has already discovered three trachodonts in the Belly River series, two with footed ischia and one Lambe's *Gryposaurus notabilis,* has an uncrested head. We have only found among our forty tons of fossil dinosaurs collected there a single species of *Trachodon.* The one we mounted from the Edmonton is certainly one. Is it possible, then, that Leidy's *Trachodon mirabilis* was a crested duck-bill? This is a question impossible of solution, as the type tooth might have come from one of three or four of the Trachodonts of the Belly River series. Then the use by Marsh of two horn cores to found the genus *Ceratops* on and the family *Ceratopsia* rests on a shaky foundation along with Cope's *Monoclonius.* These horns of Marsh might have come from any of the horned dinosaurs of that time except *Centrosaurus,* and in spite of the splendid and complete skulls of horned dinosaurs we have secured from the Belly River series we know nothing of *Monoclonius* except what little, if anything, can be learned from the types.

Then the richness of the fauna in genera and species both of duck-billed, plated, horned and carnivorous dinosaurs, was at high tide during Belly River time. The formation, therefore, must have covered a wide area, and it is not surprising to know that Brown got a *Gryposaurus* skull in New Mexico. A thorough exploration of the beds in Montana will doubtless yield rich returns. It is also interesting to note that I got a plated dinosaur some years ago in the Niobrara Chalk of Kansas, described by Weiland, doubtless a near relative of Lambe's *Europlocephalus* from the Red Deer River. Evidently then the Cretaceous dinosaurs continued to live and thrive through Cretaceous time in the west, but few bones found lodgment in the ocean sediment of thousands of feet of Dakota, Fort Benton, Niobrara, Fort Pierre and Fox Hills groups. It appears evident, too, that the life of the Pierre ocean was continuous with the Belly River, whose shores were only raised a few feet above tide water. Many Plesiosaurs found entrance to the freshwater lakes and mingled their bones with the reptilian fauna. Hatcher himself once told me he believed all the beds of the Judith River region were Pierre from top to bottom, though I suppose land, fresh water and marine beds will always be known by different names.

CHARLES H. STERNBERG

THE TRAVERTINE RECORD OF BLAKE SEA

AN outlying mass of fragmental granite projects from a spur of the Santa Rosa Mountains into the Cahuilla basin in southeastern California, the crest of the rocks rising above the ancient shore line of Blake Sea, which filled the basin to a level, something above that of present high tide in the Gulf of California.[1]

This cape is designated as "Travertine Point" in our publications, as the surface of the granite boulders is covered to a varying depth with dendritic and lithoid tufa.[2] Some marks and figures presumably carved by Indians in the travertine have long been known and were seen by us on our first visit to the place in 1906. In the continuation of our work on the Salton Sea it was realized that these figures might possibly yield some evidence as to the duration, and variations in level of the ancient Blake Sea, and of the smaller modern Salton Lake.

A visit to the formation was accordingly

[1] See Plate 1, "The Salton Sea," MacDougal, *et al.,* Publ. Carnegie Institution of Washington, No. 193, 1914.

[2] See Jones, J. C., "The Geologic History of Lake Lahontan," SCIENCE, XL., p. 827, 1914.